# Great Basin National Park
# Geologic Resources Evaluation Scoping Meeting Summary
(12/09/03)

## Executive Summary

A geologic resources evaluation (GRE) scoping meeting was held at Great Basin National Park on September 17-19, 2003 to discuss geologic mapping in the park and geologic resources management issues and concerns.

The following issues related to geology were identified during the scoping meeting:

1. **Caves -** Visitor uses and activities (touching and / or removing cave features such as speleothems, exhaling $CO_2$, vandalism, and littering, including lint and other small particles) and existing park infrastructure in the caves (e.g. cave lighting) is harming cave ecology, particularly in the more highly visited caves such as Lehman and Baker Caves. Visitor safety in the caves is also a concern to park management.
2. **Springs -** Fire suppression in the park has changed vegetation species communities which locally lowers the water table and reduces water quantities in the springs. Future groundwater withdrawals outside the park may also reduce water quantities or dry up the park's springs and streams.
3. **Streams -** Use of flood prone areas (resource management, maintenance, and residential complex and park campgrounds) poses a safety hazard to park staff, visitors and structures. Fire management activities, grazing, and the location of park roads may be increasing run-off and sedimentation in park streams.
4. **Glacial lakes -** Run-off from past mining activities in the park and acid rain deposition may be adversely impacting water quality in Stella, Teresa, Brown, Baker, Johnson, and Dead Lakes.
5. **Soils –** Sheep / elk grazing in the park denudes the vegetation, compacts the soil, and increases run-off and soil erosion on steep slopes. Water run-off on logging and mining roads and trails causes rutting, increases erosion on hillslopes, and increases sediment loads in park streams.

## Introduction

Lehman Caves National Monument was established by Presidential proclamation in 1922. Great Basin National Park was created on October 27, 1986 (Public Law 99-565) and incorporates the national monument and additional lands surrounding Lehman Cave and Wheeler Peak. The park was established in order to "…preserve for the benefit and inspiration of the people, a representative segment of the Great Basin of the Western United States possessing outstanding resources and significant geological and scenic values…" The park consists of approximately 77,100 acres of hilly and mountainous terrain in the South Snake Range. Ecosystems within the park range from high desert to alpine and rise from 6,200 feet on the eastern border of the park to 13,063 feet at the summit of Wheeler Peak.

The park lies in the Basin and Range physiographic province, and is bounded on the west by the Sierra Nevadas, the Wasatch Mountains and the plateau areas of central and southern Utah to the east and south, and the Snake River Plain in Oregon and Idaho to the north. Surface water flow in the Great Basin is unique in that all water that flows into the basin stays there, except for water lost through evaporation and evapo-transpiration.

The Basin and Range geologic province is larger than the physiographic province and extends south and eastward through Arizona, New Mexico, Texas, and into Mexico. The geologic province is characterized by uplifted and tilted mountain ranges consisting primarily of thick Paleozoic and Mesozoic rocks separated by broad, elongate, alluvium-filled valleys.

## Geologic Overview

The geology of the Great Basin is summarized by Fiero (1986). Precambrian and Paleozoic carbonate and clastic rocks comprise the thickest section of rocks in the park. Compressional and extensional tectonic activity, igneous intrusions, and glaciation have modified the distribution and thicknesses of rocks within the park.

The following generalized depositional and tectonic events shaped the geology and topography of Great Basin National Park:

- <u>Late Proterozoic (Late Precambrian)</u> Era (~1.2 billion years ago) – Rifting and extensional faulting occurred due to the break-up of the Earth's lithospheric plates.
- <u>Late Proterozoic Era – Late Devonian Period</u> (1.2 billion years ago to 360 million years ago) – Deposition on a passive plate margin occurred, similar to present-day piedmont / coastal plain areas of eastern North America. Ten to 12 kilometers (6,200' – 9,300') of carbonate and clastic (limestones, dolomites, sandstones and shales) rocks were deposited.
- <u>Late Devonian Period – Permian Period</u> (360 million years ago 250 million years ago) – Transition from a passive to an active plate margin. The Antler Orogeny resulted in crustal shortening (compressive tectonics) with low angle thrust faulting pushing older rocks eastward over younger rocks. The fault complex that overrode the rocks in eastern Nevada is called the Roberts Mountain Thrust. The park resided in a broad basin directly east of the thrust sheet.
- <u>Triassic Period – Early Tertiary Period</u> (200 million years ago - 40 million years ago) – Deformation and erosion on an active plate margin, with crustal shortening, thrust faulting, folding, plate subduction (Farallon plate beneath North America), and widely spaced granitic intrusions (plutons) in eastern Nevada. Several small landmasses collided with western North America during this time, allowing the continent to grow to the west. During the Laramide orogeny (80 to 40 million years ago), most of the folding and thrusting shifted east of Nevada into much of Utah and the Rocky Mountains. However, uplift continued across most of Nevada during this time, elevating most of the region to relatively high altitudes (possibly 4 km (~12,000 ft) or more). The continental divide may have been located near the park in early Tertiary time.
- <u>Mid Tertiary Period (40 million years ago) to Recent</u> – Transform faulting (San Andreas Fault) began along the western margin of North America. The previously overthickened and highly elevated terrane throughout Nevada and surrounding regions then collapsed and extended to form the Basin and Range province. Volcanism coincided with extensional faulting in many areas. As more of the Farallon plate disappeared, placing the Pacific plate in direct contact with North America, the San Andreas fault lengthened with time and extensional faulting and volcanism became more widespread.

  A unique and prominent structural feature in the Snake Range that formed during this period of tectonism is called a "metamorphic core complex". The Snake Range Decollment or detachment fault is a major "normal" fault that places younger on older rocks and forms a fundamental component of the metamorphic core complex (Miller, E.L., and others, Tectonics, v. 2, p. 239-263). This fault may have accommodated many kilometers of down-to-the east motion within the Snake Range. It is well exposed in the eastern part of the southern Snake Range and throughout much of the northern Snake Range. The Snake Range is internationally renowned for the extensional tectonic features in the metamorphic core complex. Fiero (1986), defines metamorphic core complexes as: "… a core of highly deformed metamorphosed and plutonic rocks overlain by an unmetamorphosed cover that has been stretched and detached from the underlying rocks….The overlying cover is primarily composed of a nonmetamorphic pile of Paleozoic and Tertiary rocks. Faults that end downward in a low angle slide plane cut the cover rocks. The slide zone called a decollment by geologists, separates the core from the cover."

Alpine glaciation in the Snake Range took place during the Pleistocene Epoch (part of the Quaternary Period). Numerous glacial features including cirques, tarns, kettles, and moraines can be seen throughout the park. At this time, the southern arm of the Pleistocene Lake Bonneville extended into the Snake Valley just east of the park. Lake Bonneville was the largest pluvial lake in the area that formed during the glacial period – it covered approximately 50,000 square kilometers and grew in size when the glaciers expanded and shrank when the glaciers retreated (Stearn, C.W., Carroll, R.L., Clark, T.H., 1979). About 30,000 years ago the lake overflowed over Red Rock Pass into southern Idaho. Great Salt Lake is the remaining remnant of Lake Bonneville. In the vicinity of the park, ancient wave cut terraces (shorelines) from Lake Bonneville dissect the alluvial fans that formed during the ice age and rim the edges of the Snake Valley.

## Geologic Fieldtrip

<u>Stop 1</u> – Rowland Spring water-quantity and water-quality gauging station - Visited spring below visitor center at Park Boundary. Gauge is one of 12 streamflow gauges within the Park that records continuous streamflow and temperature data. Gauge was installed in October, 2003. This gauge was part of a seepage run during July, 2003, where synoptic discharge measurements were made at selected reaches along Lehman Creek. A seepage run is a "snapshot in time" of discharge in streams to identify areas of gains or losses in streamflow rates. A second seepage run is planned for October, 2003.

<u>Stop 2</u> – Lehman Creek gauging station - Site has the longest period of continuous streamflow data for the Park with records available from 1947-1955, 1992-1997, and 2002-present. The gauge uses a gas bubbler system to monitor continuous streamflow as compared to pressure transducers for other gauged sites within the Park. Near real-time streamflow data is available on the web. Streamflow monitoring conditions in this area are difficult due to the steep gradient of the channel and the occurrence of many cobbles and boulders throughout the reach.

<u>Stop 3</u> – Lehman Creek scenic drive – overview of alluvial fans and pluvial lakes. Fans were most active during glacial periods and graded into pluvial lakes. Fans are currently being downcut. The surface of a gently sloping alluvial fan covers the area from Baker to the park entrance.

<u>Stop 4</u> – Mount Moriah overlook – view of Mt. Moriah, detachment fault, and extensional faulting. Detachment fault (decollment) is an undulating surface that dips under the valley in the Sacramento Pass area to the north, as well as eastward beneath the Snake Valley. Under the fault, the rocks were ductilely deformed. Snake Valley – this valley is filled with pluvial lake deposits (southern arm of Lake Bonneville).

<u>Stop 5</u> – Wheeler Peak overlook – Prospect Mountain Quartzite on Wheeler Peak peak is resistant and dips to the east. Wheeler Peak is the top of a large broad anticlinal fold in the metamorphic core complex. When the lower plate of the detachment fault was "unroofed", isostatic rebound occurred and the Wheeler Peak area was uplifted relative to the surrounding valleys. The Wheeler Peak area experienced the greatest amount of extension and unroofing in the region. The Wheeler Peak Rock Glacier was active until 1955, in 1965 it was retreating, and in the last 5 years it became a rock glacier. There are three rock glaciers in the park (Stella / Teresa, Baker Creek drainage, Wheeler Peak areas). In front of Wheeler Peak there are two cirques and lateral and terminal moraines.

<u>Stop 6</u> – Mather Overlook – view of lateral moraines on Lehman Creek and pluvial lake shorelines (on BLM lands outside of park).

Stop 7 – Prospect Mountain Quartzite crossbeds - the quartzite has a sugary texture; sand sized grains were recrystallized during metamorphism. Crossbeds can be used to infer the flow direction of water currents responsible for deposition.

# Geologic Mapping

## Geologic Maps

The Quadrangles of Interest were identified - park is primarily interested in the quadrangles encompassing the park.

-Maps at 1:1,000,000 scale – no park interest

-Maps at 1:250,000 scale – Acquire Terrascan Group map, available at Nevada Bureau of Mines and Geology (NBMG)

-Maps at 1:100,000 scale – no park interest

-Maps at 1:62,500 and 64,000 scales – park would like to locate the 1961 Whitebread map USGS PP-424-C

-Maps at 1:48,000 scale – park would like 1989 Loucks et al map of the Fortification Range, USGS I-1866 and 1969 Whitebread map of the Wheeler Peak and Garrison quads, USGS I-578

-Maps at 1:24,000 scale – review of the maps revealed:

  - Windy Peak (Miller, E.L., Gans, P.B. and Grier, S.P., 1994) – the map is not as good as other Stanford University maps, needs work, need to get it digitized
  - Lehman Caves (Miller, E.L., Brown, J.L., 1995) – also needs work, is weak, mostly surficial geology, NBMG working in area and may be able to provide coverage, Possible work or Miller PhD study, need to get existing map digitized. Lehman Caves 1:24,000 scale map is very generalized and more detailed mapping is necessary in the Quaternary alluvium.
  - Kious Spring (McGrew, A.G., Miller, E.L., 1995) – Miller has a copy, need to get it digitized
  - Wheeler Peak (Miller, E.L., Brown, J.L., Miller, D.M., Crane, M.P., McCarthy, P.T., 1993, funded through GRE program), Minerva Canyon (Miller, E.L., Brown, J.L., Miller, D.M., Crane, M.P., McCarthy, P.T., 1993, funded through GRE program), Arch Canyon (need reference) maps are complete, park wants copies, needs edge mapping, the NPS needs to get a copy of the Arch Canyon quadrangle from Phil Gans
  - Olds Mans Canyon (Miller, E.L., Gans, P.B., Grier, S.P., Hugins, C.C., Lee, J., 1999) and Cove (Miller, E.L. and Gans, P.B., 1999) – to the north, mapped, not digitized

- **Water rights issues** (Las Vegas water): park would like to have Minerva, Baking Powder Flat, and Indian Springs quads mapped. Nevada Bureau of Mines and Geology (NBMG) can possibly do the work (quadrangles are located in the southwest corner of Quads of Interest). The main issue is the Las Vegas water pipeline; west side valley pumping water first, then east.
- **Soils map**: for fire and vegetation, very high priority, would like a visit from Pete Biggam (NPS-NRID soil scientist)
- **Surficial Maps** – NBMG is working on surficial maps, could possibly put together map for entire park, possible product for new visitor's center?

## Bibliography

-Much of the information in the GRBIB is not relevant to the park.

-Add Bill Fiero reference to the bibliography.

### Reports

Not much available, only NBMG Highway 50 Guide; Roadside Geology of Nevada may be coming out, don't know quality, park get numerous requests for geologic publication about the park. NBMG indicates a possible interest in producing something for the park

## Geologic Features and Processes

### Aeolian Features and Processes

- **Biologic soil crusts**: found at lower elevations in the vicinity of terminated cattle allotments
  - -Natural Resources Conservation Service (NRCS) has generally mapped these soils (the soil associations have been mapped); two biologic soil crusts sites have been mapped in more detail.
  - -These are low importance to park management because biologic soil crusts are not located near visitor use areas and no social trails are affecting these soils at the present time.
  - -Whiptail lizards tend to live on sandy soils, which may contain biologic soil crusts.
  - -Archeological sites may be present in areas where there are biologic soil crusts.
- **Stabilized dunes**: located near administrative area outside park
- **Stressors**: no major stressors at this time. Increased visitor use could affect the biologic soil crusts in the future. Construction of the visitor center in Baker will affect the stabilized dunes outside of the park. Air pollution may affect biologic soil crusts.
- **Issues / Concerns:** none at this time
- **Inventory Needs**: Need to have the soil series mapped by NRCS. Need to map areas with biologic soil crusts.
- **Monitoring Questions / Needs**:
  - -Is the surface area of the crusts stable?
  - -Is the condition of the biologic crusts stable?
- **Is this feature considered a Vital Sign?** no
- **Contacts:**
  - -Pete Biggam – NPS-NRID (soils), (303) 987-6948

### Glacial Features and Processes

- **Rock glaciers**: at Stella/Teresa Lakes, Baker Creek drainage, Wheeler Peak
  - -Rock glaciers are highly significant to the park's ecosystem. The rock glacier located below Wheeler Peak was the only active glacier in Great Basin (it was active until 1955).
  - -Wheeler Peak rock glacier has been mapped by John Van Huzen, a UNLV graduate student. He used Ground Penetrating Radar (GPR) to determine thickness/extent. His mapping also includes moraines, kettles and tarns.
- **Glacial lakes (tarns)**: Stella, Teresa, Brown, Baker, Johnson, and Dead Lakes
  - -The glacial lakes are highly significant to the park's ecosystem.
  - -Rock dams were constructed at Stella and Johnson Lakes at the turn of the century to increase water storage capacity.
  - -There is an historic mining complex at Johnson Lake.
- **Other glacial features**: cirques, kettles, terminal moraines, lateral moraines, and frozen ground.
- **Cultural associations**: rock dam on Stella Lake, Johnson Mill (at Johnson Lake)
- **Stressors**:

-Rock glaciers: climate change, droughts

-Glacial lakes: climate change, droughts, and air pollution (acid rain)

- **Issues / Concerns**: Run-off from past mining activities in the park and acid rain deposition may be adversely impacting water quality in Stella, Teresa, Brown, Baker, Johnson, and Dead Lakes.
- **Inventory Needs**:

  -Glacial lakes: full scale water quality analysis; limnological profiles (good baseline for climate change); bathymetric measures (volume in lakes) associated with snow pack measures.
- **Monitoring Questions / Needs** (includes non-geologic monitoring information):

  -Is the water quality in glacial lakes changing over time?

  Need long-term water quality monitoring (N, SO4, core parameters)

  -Is the rate of sedimentation in the glacial lakes stable?
- **Is this feature considered a Vital Sign?** yes
- **Contacts:**

  -John Van Huzen (sp?) – Green Mountain College VT has mapped the glacial features in the park. His data are digitally available.

  -Rick Orndorff – past professor at UNLV. His students did climatic modeling in the park, plankton modeling.

  -Pete Van Meter – USGS - AZ and Mike Rosen – USGS - Carson City are coring Baker Lake and comparing it to lakes that are impacted by mining.

  -Bruce Molnia – USGS - Reston, VA expert on glacial features and processes, climatic change

  -Hal Pranger – NPS-GRD, (303) 987-6923

  -Kyle House – NBMG – Reno, NV, expert on Quaternary geology and climate change in Great Basin.

## Fluvial Features and Processes

- **Streams:**

  -Streams are highly important to the park's ecosystem.

  -Riparian areas and floodplains are likely associated with historic / prehistoric settlements.

  -Meadow complexes affect sensitive bat species.

  -Bonneville cutthroat trout is under a FWS conservation plan and is a NPS sensitive species.

  -Snails are found adjacent to the park in Snake Creek and may also be in park streams.

  -Cultural relationships include: historic/prehistoric use (archeological sites), dams for water diversions, mining activities.
- **Springs:**

  -157 springs have been identified as of 9/03, park has inventoried 13 of 25 watersheds in park, NRPP funding was used for the inventory.

  -Springs are highly important to the park's ecosystem, due to the aridity of region, and their linkage to groundwater flow and cave and karst systems in the park.

  -18 springs in the park have been restored with NPS-WRD funds.

  -Springs associated with Cambrian to Permian carbonate rocks and faulting.

  -A portion of the park's springs have been mapped and are digitally available.
- **Other Fluvial Features**: seeps; Snake River water diversion pipeline – built in the 1950's, 3 miles long; Mustang Spring – stock tanks (water troughs) for grazing
- **Stressors:**

  -Springs: climate change, droughts, external groundwater withdrawals, vandalism

-Streams: climate change, droughts, past mining activities (possible, but park has not identified soil and water contamination from these activities), fire suppression (changes vegetation species composition in the riparian areas along the streams), fires (increased sediment loading in streams, replaces stands), sheep grazing on the west side of the park (denudes vegetation, compacts soils, and increases surface run-off and erosion), droughts, roads (affects stream morphology, water quality in the streams), and campgrounds and trails (vegetation trampling and soil compaction in riparian areas)

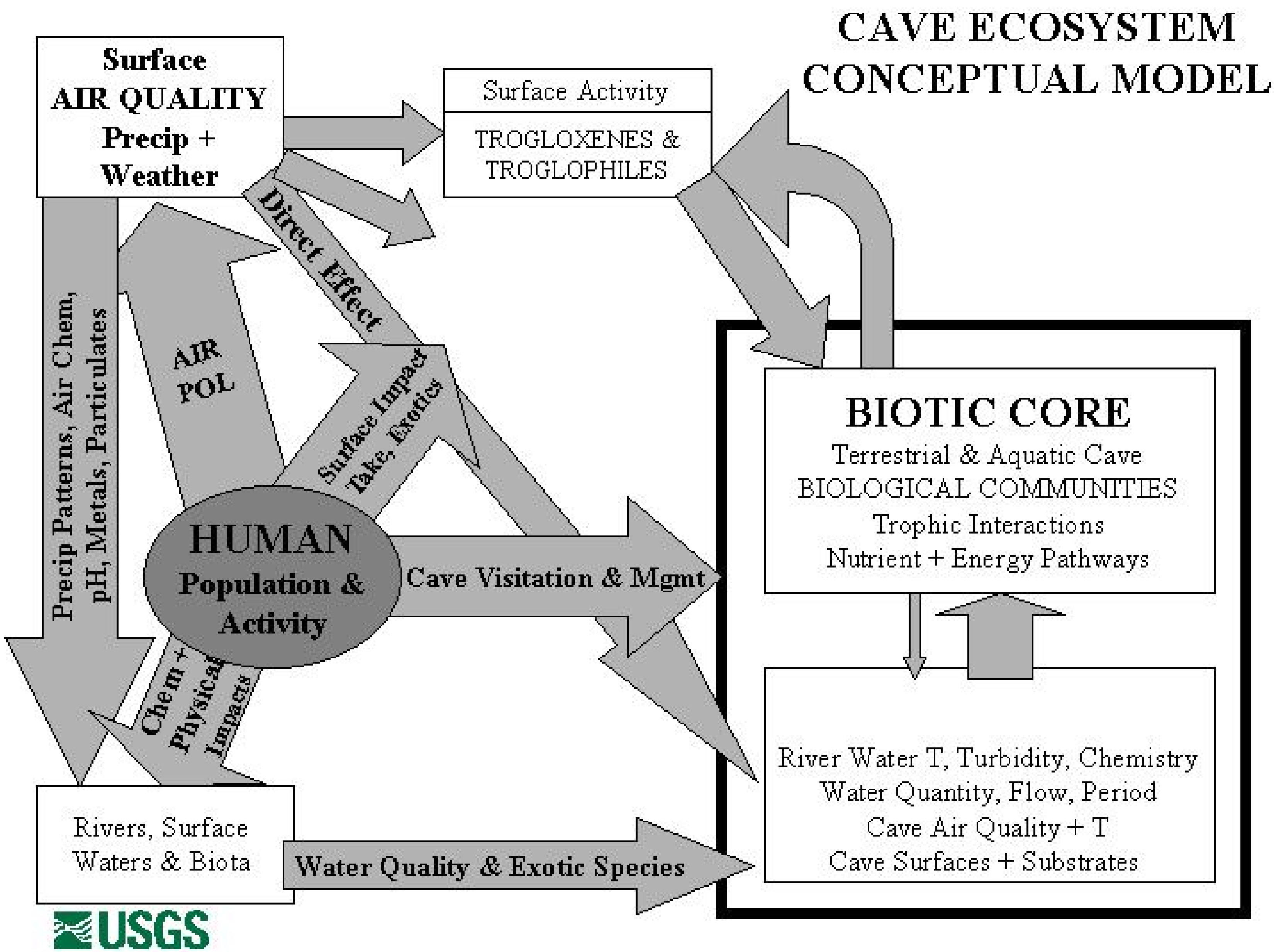
- **Issues / Concerns** (includes non-geologic issues)**:**
  - -Decreased water quality due to fire suppression (encroachment of species that require more water)
  - -Groundwater withdrawal and its impact on park resources (discharge into springs, base streamflow, caves)
  - -Sedimentation associated with fire, grazing, and roads
  - -Grazing impacts on soils (compaction, erosion, increased sediment loading in streams, biologic soil crusts) and vegetation (vegetation loss, spread of non-native species)
  - -Impacts of recreational use near water (riparian areas)
  - -Potential flooding at park's residential and maintenance complex
  - -Impacts of park use of spring water on quality and quantity
  - -Downcutting by streams may impact meadow complexes associated with areas where there is a high water table
  - -Impact on Cutthroat trout from changes in water quality
  - -Potential presence of snails in park springs (none have been found yet).
- **Inventory Needs**: Determine fire history in park.
- **Monitoring Questions / Needs** (includes non-geologic monitoring information)**:**
  - -Is water quality in the park stable?
  - -Is stream discharge changing over time?
  - -Is spring discharge changing over time?
  - -Is the surface area of riparian communities associated with restored spring sites increasing?
  - -How is stream channel morphology changing over time?
  - -Is the rate of sedimentation in park streams and springs increasing over time?
  - -How are aquatic macro-invertebrate populations changing over time?
- **Is this feature considered a Vital Sign?** yes
- **Contacts:**
  - -Dave Prudic – USGS Carson City
  - -Dave Beck, Peggy Elliott – USGS Las Vegas
  - -Bill Van Liew, Jeff Hughes, Dan McGlothlin – NPS-WRD, Water Rights Branch

## <u>Cave and Karst Features and Processes</u>

- These features have a high ecological importance to park, and highly important on a national scale.
- Longest cave, highest (11,000'+) cave, deepest (480') cave, and largest pit in Nevada located at GRBA.
- Cave systems are associated with the Cambrian - Devonian carbonates (Pole Canyon limestone, Guillmont dolomite, Lincoln Peak and Notch Peak carbonates); ¼ of park is limestone.
- **Wild cave inventory**: found 40 caves so far
  - -Conduct survey of cave and map caves (establish permanent stations)
  - -Physical inventory – identify features such as speleothems, cultural resource, hydrology etc.
  - -Put information in GIS – create 3D models that are linked to surface geology and features
- **Biologic associations**: sensitive bats (hibernacula, maternity roosts), endemic cave invertebrates, obligate cave invertebrates, packrat middens

- **Cultural relationships**: pictographs, archeological sites, burial sites (the park recently repatriated remains from Lehman Cave)
- **Biotic Indicators:** bats, cave invertebrates, vegetation
- **Physical indicators: microclimate**, water quality and quantity, human use impacts
- **Stressors:**
  -Visitor use (touching cave features, looting, vandalism, lint, breathing …), existing park infrastructure (e.g., cave lighting), air and water quality, invasive species, surface habitat alternation, climate change, droughts
- **Issues / Concerns:**
  -visitor use impacts
  -lack of baseline data
  -public safety
  -varying levels of $CO_2$ in caves
- **Inventory Needs** (includes abiotic and biotic inventorying information)**:**
  -Inventory of cave and karst resources in park.
  -Inventory cave invertebrates in remaining 32 caves in park including Lehman Cave.
  -Microbiological inventories in all park caves.
  -Dye-tracing in Baker Creek system to understand patterns of underground flow to delineate drainage divides. Dye-tracing done in Baker Creek needs to be done again to determine where water goes, how fast it gets there, and what caves are connected.
  -Small mammal inventory - packrats, field mice, and any other trogloxenes or troglophiles using the caves (important nutrient sources provide basis for cave ecosystem function).
  -Bat inventories for relative abundance and distribution.
- **Monitoring Questions** (includes abiotic and biotic monitoring information)**:**
  -Are cave invertebrate populations (species composition and abundance) stable?
  -Are the structural elements of the caves stable (e.g. movement of rocks, widening of fractures, faults, joints)?
  -Is the use of caves by small mammals changing over time (species composition, type of use, etc.)?
  -Is water input to park caves changing over time?
  -Is air quality in caves deteriorating?
  -Is the microclimate in caves changing over time?
  -Are soil chemistry and sediment loading in park caves changing over time?
  -Are caves used as maternity roosts and hibernacula by bat species in good condition?
  -Is the incidence of cave vandalism increasing over time?
- **Monitoring Needs:**
  -Photo monitoring: to determine limits of acceptable change
  -Tensiometers: movement of rocks, widening of fractures/faults/joints, detection of geologic movement.
  -Small mammals: packrats, field mice; any trogloxenes that are using the caves.
  -Hydrological monitoring: water inputs to cave (whether cave is drying over time, relation to regional climate data), determine cave fluvial relationships.
  -Air quality monitoring in cave systems.
  -Soil chemistry and sediment loading.
- **GRBA Cave Ecosystem Management Needs:**
  -Define natural limits of variability
  -Quantify thresholds for early warning indicators
- **Is This Feature Considered a Vital Sign?** yes
- **Contacts:**

-Ron Kerbo – NPS-GRD, (303) 969-2097


CAVE ECOSYSTEM
CONCEPTUAL MODEL
Surface
AIR QUALITY
Precip +
Weather
Surface Activity
TROGLOXENES &
TROGLOPHILES
Direct Effect
AIR
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Surface Impact
Take, Exotics
Precip Patterns, Air Chem,
pH, Metals, Particulates
HUMAN
Population &
Activity
Cave Visitation & Mgmt
Chem +
Physical
Impacts
BIOTIC CORE
Terrestrial & Aquatic Cave
BIOLOGICAL COMMUNITIES
Trophic Interactions
Nutrient + Energy Pathways
River Water T, Turbidity, Chemistry
Water Quantity, Flow, Period
Cave Air Quality + T
Cave Surfaces + Substrates
Rivers, Surface
Waters & Biota
Water Quality & Exotic Species
USGS

## Hillslope Features and Processes

- **Features**:
  - -Alluvial fans (downslope, outside of the park)
  - -Joints, faults
  - -Rockfalls – found near cirques (many talus slopes in park)
  - -Avalanche chutes
  - -Steep slopes – Mustang Springs area, grazing creates trails on steep slopes, loss of vegetation and accelerated erosion.
  - -Pluvial lake features – ancient shorelines (outside of park)
- **Stressors**: human activities such as road building, past mining activities, sheep grazing, climate change, droughts, increasing visitation (changing visitor demographics)
- **Issues / Concerns**: potential rockfalls (safety hazard), accelerated erosion in park (grazing, roads)
- **Inventory Needs**: Map location of basal fault on metamorphic core complex. This may help identify location of caves in the park. Map areas where there are known rockfalls
- **Contacts:**
  - -Elizabeth Miller – Stanford University
  - -Phil Gans – University of California at Santa Barbara
  - -Jeff Lee – Central Washington University

## Paleontologic Resources

- Very little is known about the location or extent of paleontological resources in the park.
- Southeast of Keyhole (Decathon) – fossils found, Rob Ewing, park ranger has information on this.
- **Inventory Needs**: Potential GIP position to make maps of potential areas with paleo. resources, first do reconnaissance surveys and follow-up with more detailed mapping
- **Stressors**: illegal collecting, erosion, development near keyhole
- **Issues / Concerns**: human health and safety concerns associated with abandoned mines, possible contamination.
- **Contacts:**
  - -Greg McDonald – NPS-GRD, (303) 969-2821

## Disturbed Lands

- **Mining** – 250 mining claims in park, with 238 near Mt. Washington. Validity has been done on 240 mining claims, all have been extinguished. Ten outstanding claims (Fenkite claims near Mt. Washington) need to have validity completed.
  - -There are no patented mining claims in the park.
  - -Mineral leasing is prohibited in the park. Mining is allowed only on valid existing rights (claims).
  - -Previous mining within the park and previous / current mining near the park includes mining for precious metals – gold and silver; base metals – copper, lead, and zinc; ferroalloy minerals – tungsten; and beryllium, a light metal that adds strength and fatigue resistance to copper, cobalt, nickel and aluminum; and fluorospar, a mineral used to remove impurities from steel.
  - -There are no current mining operations in the park.
  - -Disturbed lands and equipment / infrastructure left in the park include: abandoned waste rock, mine tailings, mining roads, mine shafts, adits, exploration pits, gravel pits, mills, and miscellaneous mining equipment throughout park
  - -Disturbed lands primarily associated with Johnson Mine, Bonita
  - -Lexington and Ponderosa Areas have been reclaimed (approximately 100 acres)
  - -Approximately 200 – 500 acres disturbed lands are remaining in the park, all Safety Environmental Class 3 areas have been reclaimed, Class 2 areas remain to be reclaimed in the park.
  - -Soil / water contamination from past mining activities has not been documented in the park

-**Impacts**: erosion and scars from past mining activities, alternation of hydrological patterns (drainage) and function, and accelerated soil erosion.

- Other disturbed lands in the park: grazing –sheep grazing on the west side of the park (vegetation removal and soil erosion); old logging roads (alteration of surface water flow, soil compaction and erosion)
- **Contacts**:
  -Dave Steensen – NPS-GRD (disturbed lands restoration) (303) 969-2014
  -John Burghardt – (303) 969-2099, Sid Covington – (303) 969-2154, NPS-GRD mining claims validity determinations,

## Unique Geologic Features

- Rock glaciers
- Caves
- Springs / seeps
- Biologic soil crusts
- Metamorphic core complex

## Current / Past Research

- Glacial features: GIP John Van Huzen inventoried rock glaciers and other glacial features in the park.
- Glacial lakes: long-term water quality monitoring (NPS-ARD long-term monitoring site)
- Sewage treatment evaporation ponds: monitor Rowland Springs for fecal coliform (park monitoring)
- Spring inventory: ongoing, NPS-NRPP funding
- Spring restoration: NPS-WRD project
- Road rehab and removal: NPS funded, also 2005 NPS funding to convert mining roads to trails
- Wild cave inventory: NPS-NRPP funding, ongoing, additional funding needed to complete inventory
- Cave gating (1998-1999): NPS gated accessible caves

## Additional Research Needs

(Possible source of assistance is listed after each research need.)

1. **Biologic soil crusts:** complete more detailed soils mapping in the park (map soil series, soil associations have been mapped) –Pete Biggam – NPS-NRID / NRCS
2. **Rock glacier below Wheeler Peak**: Determine whether the rock glacier is a glacial deposit with an ice core or a rock veneer covering an existing glacier; determine the water storage capacity. – John Van Huzen - Green Mtn. College or Bruce Molnia - USGS
3. **Glacial lakes**: Determine whether acid rain is affecting the water quality of the glacial lakes and if contaminants are leaching out of the mine tailings and contaminating the glacial lakes. – NPS-ARD
4. **Springs:** Determine how the springs relate to groundwater flow and cave/karst systems in the park, inventory biological diversity of springs – NPS-BRMD & WRD
5. **Snake River water diversion**: Determine legalities of diverting water from the Snake River. – NPS-WRD technical assistance request has been submitted for this.
6. **Flood hazards:** create flood hazard maps for the park. – Jim Faulds **-** NV Bureau of Mines and Geology
7. **Caves:** Establish baseline water quality in caves. – NPS-WRD

8. **Caves:** Determine groundwater flow, rates of flow / transport – die tracing (Baker Creek System). – NPS-WRD
9. **Caves:** Inventory invertebrates, microbiology, bats, small mammals in caves. – NPS-BRMD
10. **Reconstruct fire history** – Pete Biggam - NPS-NRID?
11. **Quaternary mapping:** Refine Quaternary portion of geologic maps to depict hazard areas etc. – Kyle House/Jim Faulds - NV Bureau of Mines and Geology
12. **Map joint systems in park:** Mapping will be used to identify relationship between joints and cave development and rockfall / hazard areas. – GIP?
13. **Add detachment fault to GIS geologic maps**: Use fault location to determine likely locations for solutional versus tectonic caves. – Phil Gans, Elizabeth Miller, NPS-GRD, Neal Darby
14. **Mining impacts:** Determine potential for erosion at Bonita Mine (millsite), core streamside to look for contamination – GIP opportunity? NV Bureau of Mines and Geology could assist with analysis of cores and sediment
15. **Determine water quality at Lincoln Adit:** – NPS-WRD
16. **Complete validity determination for Fenkite mining claims:** – John Burghardt - NPS-GRD
17. **Inventory Paleontologic resources in park** - Using GIS, do a reconnaissance survey of the potential paleontological sites in the park; follow up with a more detailed survey. – Possible GIP opportunity?
18. **Develop interpretive materials** (look at interpretive themes in current interpretive plan):
    -brochures (caves current technology – cave exploration, protective programs), mining history
    -displays for visitor center(s): work with Linda Nakata (NPS-PWR) to develop geologic interpretive materials for new visitor center in Baker and Lehman Center
    -interpretive signs: Mt. Moriah overlook
    -geologic road log through the park
    -NPS-PWR, NPS-GRD, Harpers Ferry Interpretive Center, and NV Bureau of Mines and Geology

## Park Contact Information

GREAT BASIN NATIONAL PARK
100 GREAT BASIN NATIONAL PARK,
BAKER, NEVADA 89311

Region:  PACIFIC WEST
Network: MOJAVE

### Park Contacts

Superintendent:  Kathy Billings 775-234-7331 (x202)
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GIS contact: Neal Darby 775-234-7331 (x232) - biologist
Geoscientist on staff (list discipline): Ben Roberts 775-234-7331 (x228) – Natural Resource Specialist
Krupa Patel 775-234-7331 (x228) – cave specialist

**GRE Scoping Meeting Attendees**
**September 17-19, 2003**

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| Stephanie O’Meara | Colorado State Univ. (NPS Cooperator) | Geologist - GIS | (970) 225-3584 | stephanie_o’meara@partner.nps.gov |
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# References

Fiero, Bill, Geology of the Great Basin, University of Nevada Press, 1986.

Miller, E.L., Gans, P.B. and Garing, J., 1983, The Snake Range decollement:  an exhumed mid-Tertiary ductile-brittle transition:  Tectonics, v. 2, p. 239-263.

National Park Service, Final General Management Plan, Development Concept Plans, Environmental Impact Statement, Record of Decision, and Impact Mitigation Matrix – Great Basin National Park, 3/92, FES 92-33.

Stearn, C.W., Carroll, R.L., Clark, T.H., Geological Evolution of North America (John Wiley and Sons, Ed.), 1979, pp 503-504.